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## **Exploring the hidden potential of sugar beet industry brownfields (case study of the Czech Republic)**

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### **Abstract**

The paper focuses on spatial analyses of sugar beet industry brownfields in the Czech Republic. In the first part of the paper history of sugar beet industry on the area of the Czech Republic is briefly presented, then links between location of these sites and its transport potential are discussed. Benefits of brownfields regeneration for regional development are also evaluated. In the empirical part of the paper 49 brownfield sites within the Czech Republic, where the sugar beet industry was abandoned during the transition period after 1989, are evaluated and classified based on field research and aerial picture analyses. Three examples of reuse of former sugar beet factories are finally presented. It was found that development potential of studied sites is highly depended on their geographical location and some inspiration might be derived from presented examples. More targeted supportive policy in the Czech Republic to support regeneration of brownfields is needed. In the concluding part of the paper further development possibilities of sugar beet industry brownfields and their railway connection are considered.

### **Keywords**

Brownfields regeneration, Czech Republic, Railway, Regional development, Sugar beet industry brownfields

### **Introduction**

The sugar beet industry in the Czech Republic has been experiencing a dramatic period full of changes since the societal turn in 1989, which heavily affected extent and structure of the food industry and related agricultural production in the country. These changes can be in case of sugar beet industry characterised by significant shifts in ownership structure of land and sugar beet factories, their closures, by consequent changes in distribution channels of sugar, by a massive decrease in sugar beet sowing areas, and by strong concentration of sugar beet growing in the most suitable natural conditions with a consequent increase in sugar beet yields. Currently there operate in the Czech

Republic just seven sugar factories, quarter-century ago it was more than fifty, one and half century ago it was almost four hundred. Dozens of sugar factories have been closed and abandoned in the course of the last one and a half century during cyclical ups and downs of the sugar beet industry in the Czech lands. After nationalisation of whole sector at the early times of the communist era after the end of World War II and implementation of planned economy with huge state interventions development was followed in the 1970s by a restructuring of the industry by means of grouping of sugar beet factories into large state companies, and later by the effects of the political and economic changes of early 1990s, causing the return of the market economy, renewal of private ownership of companies, and finally by the European Common Agricultural Policy after the accession of the country to the European Union (2004).

Such dramatic development caused frequent occurrence of abandoned or underused sites, where sugar beet industry used to operate for decades. Those buildings and areas of former sugar beet factories, which are nowadays looking for a new utilisation, can be marked as a specific type of brownfields, so called sugar beet industry brownfields (brownfields remaining after the sugar beet industry). These sites are with respect to their long industrial tradition usually marked by very good transport connections and accessibility. It can be assumed that regeneration of these areas has an important influence on the formation, development, and functionality of given settled areas, and that utilisation of the forgotten transport potential of sugar beet industry brownfield sites can be perceived as a possible impetus for making these (usually spacious) sites viable again.

The aim of this paper is to analyse the transport connections of sugar beet industry brownfields in the Czech Republic and to evaluate their overall development potential. In the analysis 49 sites within the Czech Republic, where the sugar beet industry was abandoned during the transition period after 1989, are discussed. The paper methodologically builds on the previous paper by Krejčí et al. (2014), where more attention was paid to recent development of sugar beet industry brownfields in the Czech Republic and their categorisation from the perspective of utilisation and functionality. To follow-up previous study, within this paper transport potential is assessed with an emphasis on rail transport, which has been experiencing in the last two decades distinct changes. Whilst rail transport (railway sidings) has been facing in studied cases in the Czech Republic a rather negative process of liquidation, quality of road transport has reached in a majority of cases at least minimal improvements. These railway sidings to abandoned sugar beet factories and connected sites are commonly classified as brownfields.

## **Theoretical background**

### *The sugar beet industry in the Czech Republic – A brief history to the present*

The history of the sugar beet industry in the Czech lands might be recorded from the end of the 19th century but 1829, when the sugar beet factory was founded in Kostelní Vydří in the south-western part of Moravia, is usually considered the true year of origin (for more details see Gebler et al., 2007). During the course of the 19th century the sugar beet industry became a crucial part of the contemporary economic and industrialisation process of the Czech lands. Some authors even rate the sugar beet industry amongst the very most important branches (with engineering and textile industries) of contemporary industry heavily affecting the newly formed industrial society. Such booming development also naturally influenced other branches of industry, agriculture, and the dynamics of coal mining development. Simply stated, it was necessary to improve the modes and capacities of raw material transport to the processing factories and to enable quick and flexible transport of the outputs of the sugar beet industry to their final consumers. Thus extensive development of the rail transport network within Czech lands was caused. As recorded in the paper by Havlíček et al. (2013), significant changes affected the landscape and its utilisation in the context of sugar beet growing. They argue that landscape changes as result of long term growing of sugar beet caused a reduction of water surfaces (i.e., the desiccation of ponds) and an abatement in the extent of permanent grasslands. Vyskočil (2010) addresses the social impacts of the huge development of the sugar beet industry during the 19th century. According to the study of Málek (2010), the sugar beet industry might be perceived as an integral part of the Industrial Revolution of the country since the

1850s. Massive spreading of steam engines to sugar beet factories as an example of an important innovation heavily affecting economic development has been widely discussed by, e.g., Jakubec et al. (2007).

From the geographical point of view, mass production of sugar beets was concentrated within the Czech lands in the areas with fertile soils between rivers (e.g., between the Ohře River and the Vltava River basins, along the Labe River and the Morava River basins). The latter two of these areas are usually considered as an example of the developmental symbiosis of the sugar beet industry and the railways (Vyskočil, 2010).

At that time, it was the core railway network in the Czech lands (incl. Kaiser Ferdinand Nord Bahn (KFNB)), along which new sugar beet factories were founded (see the study on the Hodonín region by Havlíček et al., 2013). This main railway arteries were gradually complemented by local and branch lines (see Schreier, 2004). This phase of railway development can be placed in the period from the 1860s to the 1890s.

It is indisputable that both sugar production and railway development have particularly contributed to the development of given regions and localities. The importance of transport for both local and regional development is indisputable. As stated by Dostál and Adamec (2011), transport has to be considered as an important pillar of the economy, and economic impacts of transport on areas is of great importance (e.g. MacKinnon et al., 2008; Banister and Berechman, 2000; Rephann, 1993; Rietveld and Nijkamp, 1992). Marada et al. (2006) discuss the concept of positive impacts from the construction of transport infrastructure, taking the example of transport accessibility improvements in peripheral areas. Transport enables and determines a variety of human activities; transport of goods means a strong economic flow with clear and defined sources and destinations. Moreover, as argued by Rodrigue et al. (2009), strong transport of goods is typical for urban spaces, whose positions as centres of the economy are thus emphasized. The importance of cities as strong centres of both production and consumption gradually rises and enables the development of still stronger mutual relations between individual centres. Such development might be evidenced at the international (Vienna-Bratislava), national (Prague-Brno), or regional levels (for example in the case of eastern Bohemia – see Seidenglanz, 2010; Halás et al., 2014, or Kraft et al., 2014 for regional centres of the Czech Republic). According to Rodrigue et al. (2009), effective transport systems create the preconditions for specialisation of regional economies (Michniak et al., 2015). Transport accessibility is usually marked as an integral part in many strategic documents, and as one of the key factors for development (in the case of the Czech Republic, e.g., The Strategy of Support for Regional Transport Services of the Czech Republic, The Transport Policy of the Czech Republic; The Strategic Framework for Sustainable Development of the Czech Republic, etc.).

After communist putsch in late 1940s the food industry in contemporary Czechoslovakia was nationalised, which significantly affected further development, structure and extent of Czech sugar beet industry. Fundamental changes were also experienced in the period since 1990, when market economy was resurrected. The sugar beet industry as a strongly protected branch of the economy in the communist era dramatically changed its position. The sugar beet industry was liberalized and market economy relations applied, with the whole system of a nationally owned sugar beet company being dismantled and individual factories privatized (Gebler et al., 2007). This development also opened the possibility for foreign companies to buy and invest in Czech sugar beet factories. These new foreign owners, usually with a strong capital background, heavily influenced the whole sector, since the local sugar beet entrepreneurs were not able to compete with them. The crucial mechanism by which the sugar beet industry has been particularly influenced since EU accession is the EU Sugar Regime. This set of EU sugar beet regulations affects the production of sugar by means of production quotas, a subsidised price of sugar beets, and other regulations (see e.g. Strnadlová, 2009). These regulations have caused a distinct reduction in the number of operated sugar beet factories in the Czech Republic, from 56 factories operated in 1989 to seven sugar beet factories surviving in operation today (in Dobrovice, Hrušovany nad Jevišovkou, Litovel, Opava, Prosenice, České

Meziříčí, and Vrbátky; an eighth case, a factory in Mělník, has recently been operated only as a sugar packing plant).

Today, within the Czech Republic only a very limited use of rail transport of sugar beets to factories can be recently recorded (from the Opava region to Hrušovany nad Jevišovkou, between two sugar beet factories under the same ownership). On the other hand, an example of seasonal transport of sugar beet molasses between the Opava and Hrušovany nad Jevišovkou sugar beet factories to a distillery in Kojetín (central Moravia) is regularly evidenced.

### *Transport and brownfields*

The National Brownfield Regeneration Strategy of the Czech Republic (2008) defined brownfields as properties (land, buildings, areas) that are underused, neglected, and potentially contaminated. They usually occur as relicts of various types of previous activity – industrial, agricultural, residential, military, transport, or other. This paper focuses on the analysis of one type of brownfields after transport, researched from the point of view of the driving forces behind their occurrence, their spatial coherences, and the specificities of their regeneration options (see the importance of transport factors for regeneration options in Table 1). So-called transport brownfields, unused areal and linear transport constructions, are usually listed within other, more common brownfield categories, with which unused transport constructions are functionally linked (especially industrial brownfields – see Vojvodíková et al., 2011). This methodological problem considerably limits possibilities for regional and inter-regional analyses. Even amongst the categories given in the Search Study for the Location of Brownfields in the Czech Republic developed by the CzechInvest Agency (2007), transport brownfields are not listed. Generally it can be noted that amongst the 2355 brownfields, occupying 10 362 hectares, listed in the mentioned study, transport brownfields make up an important part that seems to be quite under-researched from the perspective of geography.

Table 1. Importance of transport factors for possible modes of brownfield regeneration.

	Highways and motorways	Roads (1st class)	Railway – main corridors (TEN-T network)	Railway – national and regional
Light industry, logistics	+++	++	++	+
Heavy industry	++	+	+++	++
Housing	+++	+++	+	0
Shopping mall	+++	++	0	0
Tourism	+	++	+	+
Administration	+++	++	+	0

Source: authors.

The transport brownfields can be principally divided according to the basic types of transport constructions (see Table 2 for basic division) – unused transport constructions previously utilised for the movement of transport vehicles (e.g., roads, railways, airports), and other transport infrastructure, by which we understand unused necessary support constructions for transport (e.g., railway stations, airport terminals, river and sea ports, etc. – see Brinke, 1999). Both mentioned types report certain specificities and differences concerning regeneration possibilities. Whilst the reuse of former main railway or bus stations, usually located at nodal points in proximity to city centres, shows significant attractiveness for possible investors, the reuse of former, now abandoned linear constructions seems to be quite challenging without huge investments. However even here certain specificities can be identified. Regarding the terrain configuration of some defunct railway tracks and their mild slope,



remodelling into cycle or foot paths for use by both tourists and by the local population might be considered (Kazimierczak, 2012; Navrátil et al., 2013, 2015). Such new trails within cities might serve as examples of a more sustainable approach to urbanism (Mashayekh et al., 2012). With respect to the high density of railways in the Czech Republic, a decrease in demand for railway transport in the country, and pressure for reorganisation of local railway connections, it can be assumed that reuse of linear transport brownfields will become more popular in the near future.

Table 2. Types of transport brownfields.

From the perspective of transport mode	From the perspective of importance within transport network	From the perspective of location within settlement system
Railway	Local, regional, international	Inner city
Road	Local, regional	Outskirts of the city
Water	Local, international	Rural space
Aviation	International	Outskirts of the city
Pipelines	Translational	Outskirts of the city/rural space

*Source:* adapted based on Rodrigue et al. (2009).

As evidenced in a wide set of publications, many reuse options for transport brownfields exist. The possibility of greening spacious brownfield sites is discussed by, e.g., Braswell (1999). Franz et al. (2008) and De Sousa (2003) explain that purpose-grown greenery on brownfield sites might be employed as an interim use for sites until another suitable use is found. This might be a way of ensuring that brownfield sites are not left completely abandoned and unused. The benefits of this reuse option for urban climate are obvious (Středová et al., 2015). The contributions of this approach are widely discussed from the perspective of environmental, health, and aesthetic benefits, with examples in various European (Haase, 2008; Rall and Haase, 2011; Krzysztofik et al., 2012, 2016; Kunc et al., 2014; Doleželová et al., 2014; Tintěra et al., 2014; Frantál et al., 2015) and American cities (De Sousa, 2003; Siikamäki and Wernstedt, 2008).

## Methodology

The aim of this paper is to evaluate the development potential of transport connections (railway sidings) of sugar beet industry brownfields in the Czech Republic. The set of evaluated brownfield sites has been generated on the basis of a list of sugar beet factories in operation at the end of 1980s, that is to say at the end of communist era in the former Czechoslovakia, but which in the following two decades lost their original function (49 sites in total).

This set of the sugar beet factories has been divided into four categories according to the level of utilisation/abandonment of individual sites (A–D types). The types of crucial interest for the purposes of this paper were types B, C and D. (The A type consists of sugar beet factories still in operation) This typology has been based on an analysis of the state of individual areas as of 2013 (see Krejčí et al., 2014), however in the case of several sites it was quite difficult to conclusively assign a particular type. Generally the following types were finally defined:

- A type – sugar beet factories in operation (i.e., sugar is still produced there).
- B type – Regenerated sugar beet factories whose regeneration has been undertaken with an eye on preserving sugar beet industry heritage. At least part of the original sugar beet factory has been preserved. Not all buildings were demolished and part of the original buildings have been renovated. Reminders of their past sugar beet identity are visible.

- C type – Regenerated sugar beet factories whose regeneration has been performed without regard to their sugar beet industry heritage. Sugar beet industry heritage has been lost, all buildings have been demolished, and there are no visible reminders of their original sugar beet identity.
- D type – Former sugar beet factories without any regeneration intervention. Sites are abandoned and neglected. Some interim use is obvious but they are without essential interventions.

Within this paper the strongest attention is paid to the railway connections of given brownfield sites. The majority of studied sites were visited during the field phase of the research (during spring/summer 2014), when the present states of whole sites and particularly the state of given railway sidings were documented. All sites were also evaluated by means of aerial picture maps (aerial pictures originating in the Czech Office for Surveying, Mapping and Cadastre, and covered time horizons of 2012 and 2013) and available GIS shapes (GIS shapes ZABAGED at scale 1:10 000). The shapes have also been utilised for evaluating the overall situation of individual former sugar beet factories. This approach allows the assessment of the level of gradual decay or regeneration and of the development of individual sites. For evaluation of the development of individual former sugar beet factories and their respective transport infrastructure, other additional materials were also exploited: a set of aerial pictures from the years 1999–2009 (GEODIS) and basic maps of the Czech Republic from the 1990s (scale 1:10 000). The area of identified railway sidings has been digitalised, transformed to vectors, and the GIS shape was produced to enable more sophisticated GIS analyses.

As the result of the previous steps, four types of the railway sidings have been defined:

- A type – railway sidings in operation (whether by a sugar beet factory or another company).
- B type – Railway sidings that have been preserved, including majority of necessary equipment but nevertheless unused for a long time.
- C type – Railway sidings have been dismantled but the body of the line is preserved, thus the renewal is still possible.
- D type – Railway sidings have been dismantled and the body of railway already used for other purposes, thus renewal is practically impossible without enormous costs.

The listed types of railway sidings were compared to the contemporary state of their respective sugar beet factories, for which the information gathered during the field research phase was utilised. Because the railway connections of sugar beet industries is just one part of the overall transport connection of the studied sites, total transport accessibility of sites and temporal changes linked to new functions of sites have also been evaluated (such cases were in evidence in the South Moravian Region).

## Research results

As mentioned above, the presented research comprised the set of sugar beet factories that used to be operated on the territory of the current Czech Republic at the end of the 1980s. The total number of factories is 56, seven of which are still in operation. In the following analysis, 49 former sugar beet factories are considered. Railway sidings were constructed in all but one factory, the exception being in Dřevohostice. However, in the case of Vyškov, the railway siding has already been dismantled in past, and thus those two factories are not part of following analysis.

The total length of all railway sidings connected to former sugar beet factories amounts to 40 km (the total from the seven still operating factories is 5.2 km). The analysis of the recent state of these railway sidings showed that with the gradual decay of the former sugar beet factories, a decay in their sidings has also been taking place. This fact can be documented by the proportion of types C and D type railway sidings (those dismantled or totally liquidated) in the full set. The C and D types make up about half the total number of studied railway sidings in the Czech Republic (23 in total, 17 of them C type), and their distribution across the country is rather even. The importance of dismantled railway sidings (C type) can also be shown in their collective length, which exceeded 20 km (see Table 3). It is obvious that both these types of railway sidings are either impossible to return to their transport

function or prohibitively expensive. These linear constructions might only be used in a regenerated form, for example as a cycle path or for the construction of a new local road. On the other hand, the railway sidings that are mostly preserved or even still in operation are clustered in the Kladno region (in central Bohemia) and in the Nymburk region (on the borders of central and eastern Bohemia). Nowadays there are twelve railway sidings in operation with a total length exceeding 9 km, and the same number of railway sidings are preserved in principle but out of operation (with a length of 7.6 km). The economic efficiency of the railway sidings in the case of operating sugar beet factories might be documented by the fact that six of the seven factories have their railway siding in operation (A type), with just the factory in Prosenice maintaining but not utilising their siding (B type).

Table 3. The length of analysed railway sidings according to individual types.

	Type of railway siding				
	A type	B type	C type	D type	In total
Number	12	12	17	6	46
Length (km)	9.2	7.6	20.5	2.9	40.0

Notes: within the table still operating sugar beet factories are not included (7 factories); two other factories are also not taken into account, as either a railway siding has never existed there (Dřehovostice) or it was liquidated before the start of the transition of the sugar beet industry (Vyškov).

Source: own research.

If we focus now more on the railway sidings that have already been liquidated, it might be stressed that the areas remaining after their removal have been re-used in just five cases (Dolní Bečkovice, Hodonín, Némčice nad Hanou – part of siding, Nymburk, Slavkov u Brna). The evidenced reuse options differ considerably – residential development, heat pipeline, photovoltaic power plant, and road. In two type D cases, sites were without any use as part of an industrial zone (Lovosice) or identified as an empty development area (part of former railway siding in Némčice nad Hanou). More complex information on individual sites can be obtained when both evaluations (sugar beet factories and sugar beet factory railway sidings) are combined (for more details see Table 4). If marginal combinations of types are ignored (for example the AC type, i.e. an operating sugar beet factory with a dismantled railway siding, as in the case of Mělník), it is obvious that a combination of regenerated area unconnected to sugar beet heritage and dismantled railway siding prevails (CC type, a typical case being that of Postoloprty). A high representation has also been shown for DB type (6 factories, a typical case being that of Drahanovice), CA type (5 factories) and DC type (5 factories). The most common type of sugar beet factory is type C (sugar beet factory regenerated without any respect to sugar beet heritage), at which the largest number of dismantled railway sidings were observed but also the most still operating railway sidings. The group of non-regenerated sugar beet factories (D type) offers lower numbers of operating railway sidings. However half of their railway sidings are out of operation but still in quite a good technical state, meaning that they might be returned to transport usage without huge investments. As rather positive information we can also add that the same number of railway sidings have at least the body of the railway preserved. On the other hand, six railway sidings have been completely demolished, represented similarly in cases of both types of brownfield regeneration (typically in Némčice nad Hanou, Hodonín).

Table 4. Types of use of sugar beet factories and use of the railway sidings.



		Railway siding type				
		A type	B type	C type	D type	In total
Type of use of factory	A type	0	0	1	0	1
	B type	3	3	1	2	9
	C type	6	3	10	4	23
	D type	3	6	5	0	14
	In total	12	12	17	6	47

*Source:* own research; note: for railway siding type – see methodology above; for type of use of former sugar beet factories – see methodology above and Krejčí et al. (2014) for more details; seven still operating sugar beet factories have not been included in the table, whilst a factory where sugar is just packed has been (Mělník – AC type); the sugar beet factories in Dřevohostice and Vyškov are not included, as in these cases the railway siding was not built at all (Dřevohostice) or had been dismantled a long time ago before the transition process began (Vyškov).

The map in Fig. 1 illustrates the distribution of former sugar beet factories in the Czech Republic along with the typology of recent functional use of the sites and recent use of their railway siding. On the basis of the map it can be stated that defunct sugar beet factories, whose operation was ended after 1989, are concentrated in seven of fourteen regions of the Czech Republic. We can also read from the map that the majority of the former sugar beet factories are located in Bohemia (32 former factories in the Central Bohemian Region, the Hradec Králové Region, the Ústí Region, and the Pardubice Region), with one third located in Moravia (15 former factories in the Olomouc Region, the Zlín Region, and the South Moravian Region). The regeneration of sugar beet factories where sugar beet heritage has been taken at least partially into account are however more frequent in Moravia (five cases) than in Bohemia (four cases). Out of fourteen former factories without any regeneration intervention whatsoever, ten of them are located in Bohemia and four in Moravia.

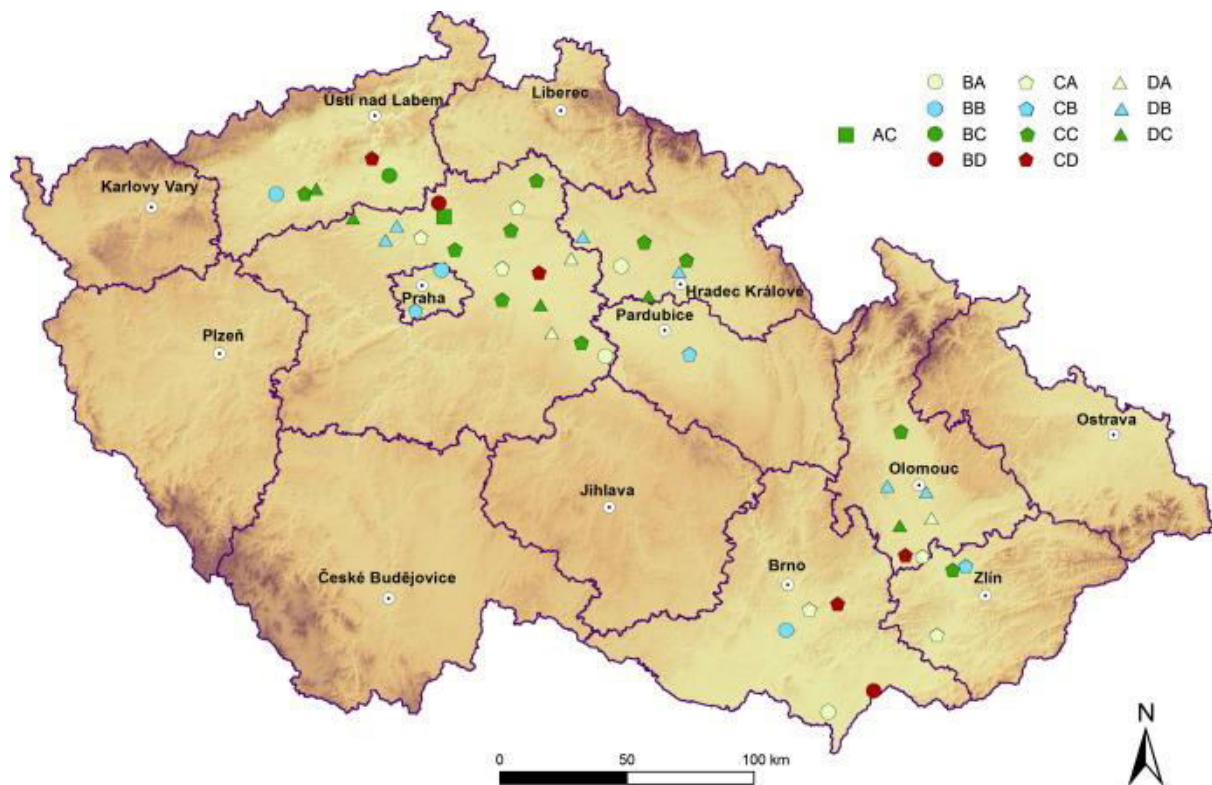


Fig. 1. The combination of types of use of sugar beet factories and uses of railway sidings.

*Source:* own research; note: the first item of the legend defines the recent use of an area of a sugar beet factory and it is symbolized by a geometrical symbol (A – square, B – circle, C – pentagon, D – triangle); the second item of the legend expresses the recent use of the railway sidings at the sugar beet factories and is differentiated by colour (A – olive yellow, B – apatite blue, C – leaf green, D – tuscan red). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Nowadays operating railway sidings on the site of former sugar beet factories can be found in both Bohemia (seven cases) and in Moravia (five cases); in Moravia their share is higher. The number of defunct railway sidings without any regeneration possibility is the same in Bohemia and Moravia (three cases each) but in Moravia this amounts to one fifth of all former sugar beet factories, whilst in Bohemia just one tenth. Examples of successful regenerations of railway sidings are quite rare and unique in the Czech Republic. Just two such cases from recent times can be identified, both from western Bohemia and not connected to sugar industry in any way.

The first one is the renewal of part of the former local railway from Krásný Jez to Nové Sedlo u Lokte, which had been abandoned for more than ten years, although the body of the railway and part of railway track was preserved (the B type of railway siding). This regeneration was undertaken by the Railway Infrastructure Administration Company for the Legios Company, which is focused on freight wagon production (in Ležnice, part of Horní Slavkov, the Karlovy Vary Region). Investment into the 5 km long line exceeded €700 000.

The second example of a regenerated railway siding is the quite famous rail line from Vojkovice and Ohří to Kyselka (near Karlovy Vary). This siding is operated by the Mattoni Company for the transport of their products (mineral water). This formerly unused 8 km railway siding (before regeneration transition type BC) was returned to operation in 2012, after an investment of €350 000. It is obvious that no general conclusions can be made concerning the regeneration costs of railway sidings based on just two examples. Nevertheless, an estimation of between €80 000 and €180 000 per kilometre of track can be made based on terrain conditions and the preservation of the original body of the railway. It is also indisputable that regeneration of the B type of railway siding is much less expensive than that of C type, since at least something of the original railway construction has been

preserved. In situations where neither important part of the construction actually exists any longer (D type), it is difficult to discuss regeneration from an economic point of view, as it is almost impossible due to the enormous investments necessary (although, for example, the reuse of a cycle path as a rail corridor might sound easy in theory).

The location of the areas of former sugar beet factories within municipalities is the crucial element for their transport potential. Out of 49 former sugar beet factories, almost three quarters (36 sites) are located on the margins of given settlements or even out of settled areas. Only in 13 cases were the sugar beet factories located within inner areas of municipalities. All recently operating sugar beet factories are sited on the margins of settled areas of municipalities or out of them completely. This is not surprising in the case of newly built factories, as new industrial developments were usually situated on “green fields” during the 20th century. This “tradition” of building-up on green fields has strong supporters to the present day, in spite of obvious environmental problems connected with the wide occurrence of abandoned brownfields. If we consider the development potential of brownfields, the question arises as to which location might be more beneficial for future use. It seems the rational assumption to assume a higher development potential in cases of sugar beet factories located on the margins of settled areas of municipalities. The reason might be explained in several points: (i) more suitable transport accessibility – transport doesn’t cause environmental problems in settled areas of the municipality; (ii) possibility of further expansion according to investors’ plans; (iii) better connection to main roads, or more space for the renewal of the railway siding. All mentioned points might serve as rationales for locating industrial activities. On the other hand, the location of brownfields within the settled area of municipalities encourages the integration of the sites with the urban organism in the form of residential housing (as in the case of Nymburk), areas for leisure time activities, or areas for various types of services. In the case of smaller municipalities, reuse for production activities was also observed (as in the cases of Bedihošť and Němčice na Hané). In this case the transport accessibility of a former factory location is of marginal importance, since more crucial is the accessibility of whole municipality in the transport system.

## Discussion

The previous introductory analysis of the recent state of former sugar beet factories is just the first step in the identification of development possibilities for given localities. In the second phase the question appears, which assessed areas have the best transport potential, i.e. the best preconditions for future use. It is obvious that some areas, no matter whether partly regenerated or used, have already proved their development potential without the necessity of connecting to a railway. Such cases might be utilised as examples of best practices or as inspirations for other, less successful sites. At the opposite end of the spectrum, sites not already regenerated with very limited potential for present use might also be found (D type). From the perspective of railway connection, these sites are listed within different types (the A, B, C types of railway siding).

Only in cases of areas of former sugar beet factories of the DA, DB and DC types does it make sense to evaluate the possible development potential. The D type of former sugar beet factories has been observed in 14 cases. It must also be stressed that a majority of these sites are at least partially utilised even without any regeneration intervention. With respect to the original use of sugar beet factories and to the combination of the present state of a given railway siding and the location of individual sites (in the inner part of a settled area or on the margins of the settlement), we can discuss the development potential of individual sites in relation to various new reuse activities (as similarly stated in Table 1 whilst discussing the importance of transport factors). The six possible types of reuse activities might be considered.

When we analyse non-regenerated sugar beet industry brownfields in more detail, it can be stated that the highest potential for reusing sites can be seen in light industry or in logistics, where demands as to space and location are similar. With the exception of one sugar beet industry brownfield (Lenešice – a residential zone is considered here), the development potential for light industry can be evaluated at a level of ++, and in case of Drahanovice and Brodek u Přerova even at the level of +++, since available areas and building are actively utilised here. It is quite paradoxical that Drahanovice contends with

probably the least accessible location, since this brownfield site is of the D type located the greatest distance from upper-regional railways and roads. The issue of regeneration of former sugar beet factories to heavy industry is not so clear. This is the case in half of available areas, predominantly ones located in proximity to important railway lines or in spacious areas outside of the settled area of municipalities, which are well connected to important roads (e.g., Klobuky). But the overall importance is lower here and the evaluation +++ might be assigned just to the former sugar beet factory in Brodek u Přerova; with certain problems Předměřice nad Labem might be also considered. In these cases, the railway sidings are a substantial development factor for given localities.

Non-industrial uses of former industrial areas are quite a frequent option for making a given locality viable again. In our opinion, in the case of sugar beet industry brownfields the highest potential might be seen in regeneration for housing; this is partly due to good accessibility and similarly due to a very good location within the settled areas of municipalities. With the exception of large sites located out of settled areas, where a bigger potential can be seen in production activities (see above), in the case of nine localities housing as a regeneration option might apply. The highest evaluation +++ attaches to former sugar beet factories in Lenešice (such a possibility in the foreseeable future is even discussed in the literature; see Veselý, 2014) and in Olomouc-Holice. Although the former sugar beet factory in Olomouc-Holice is located on the margins of the city and is surrounded on two sides by industrial and (frequently newly built) logistic facilities, a direct connection of the site to an existing housing zone in Olomouc-Holice exists. The site is also directly reachable via nearby public transport stops and via the road from Olomouc to Přerov and the highway in the direction of Brno. A significant advantage can also be seen in the attractiveness of Olomouc as the regional capital of central Moravia. The regeneration of a sugar beet industry brownfield for housing might be also apply in Kopidlno (in the Hradec Králové Region), where more than 2000 inhabitants live, and where the given site is located in the central part of the municipality. However, regeneration of this site for housing is limited by its listing by the regional administration of the Hradec Králové Region as a site where production and public amenities are planned (leisure time area, use for cultural events, etc.).

Other regeneration options for former sugar beet industry factories can be evaluated as marginal. The question of shopping mall use or of use for administration could be seriously considered only in the case of Olomouc (with the largest potential in reuse as a shopping mall), and partially in Předměřice nad Labem (in proximity to Hradec Králové as a regional centre with access to national core transport infrastructure); in the case of the next five sites, an evaluation of only + can be considered. Tourism as a reuse option is very marginal; only in the cases of five sites can a possibility for tourism reuse be seen at all, these however only evaluated as +. A higher evaluation (++) was indicated for Lenešice, where housing reuse is primarily planned. The proximity of the city of Louny (partly of Žatec), and also the proximity of the Czech Central Mountains and the Ore Mountains, also place the development of tourism accommodation services and connected activities into consideration. As already stated in a previous text, identifying the regeneration potential of given sites is the first step towards assessing possible options for brownfield regeneration or for simply showing directions and possibilities for improving and effectively using given sites. This approach can be suitably supplemented by a presentation of best practices, i.e. examples of regeneration which worth to take into account whilst thinking about regeneration similar brownfield site. For the purposes of this text, three examples of best practices have been selected. The presented examples are located in the Czech Republic and represent various regenerations of former sugar beet factories. Specifically, the following text is devoted to:

- (a) The regenerated area of a former sugar beet factory in Hodonín (in the South Moravian Region), which was rebuilt into a shopping mall.
- (b) The regenerated area of a former sugar beet factory in Nymburk (in the Central Bohemian Region), which was regenerated for housing (a local railway siding included).
- (c) The regenerated area of a former sugar beet factory in Němčice nad Hanou (in the Olomouc Region), which has been partially reused for energy purposes by the installation of a photovoltaic power plant, which also covers the space of the railway siding.

*Sugar beet factory in Hodonín (type BD)*

The sugar beet factory in Hodonín was located in direct proximity to the railway in 1886. The area has experienced many reconstructions and modernizations of technology during the subsequent course of time. The last important reconstruction of the factory was accomplished around the hundredth anniversary of the factory, when the area was supplemented with housing for sugar beet factory workers. The operation of the sugar beet factory in Hodonín ended in 1994, and a gradual decline in the area has been experienced since then. The remains of the former factory were demolished in 2004. Nowadays a large shopping mall is located on the site, which has significantly increased the retail offerings of the city of Hodonín (with a population of about 25 000).

The area can be classified as type B according to the typology introduced above. Although a total transformation of the area has been effected, nonetheless the storage tower of the original factory has been preserved as a commemoration of the area's industrial history. After construction of the shopping mall, a minor local street was named after the founder of the factory, Adolf Redlich. The sugar storage tower (see Fig. 2) is still used by the sugar beet factory in Hrušovany nad Jevišovkou.



Fig. 2. The sugar storage tower of the former sugar beet factory in Hodonín. Current operation might be evidenced by the tank truck with sugar in the picture. Photo: M. Havlíček, 2014.

The area is not directly connected by means of the railway siding, however its location in immediate proximity to the railway station cannot be regarded as negligible. Fundamental modifications to the road connection of the area happened with the regeneration of the area; as an aid to the development of parking facilities in the area, two new roundabouts were built and cover of the road have been



adapted as well (see Fig. 3). During the construction of the shopping mall, three new streets within the area of the former sugar beet factory were constructed, Krátká Street, Obchodní Street, and the already mentioned Redlichova Street. Completely new functions of the area appeared, complementing the existing urban organism of Hodonín. From the point of view of brownfield regeneration, this can be called a successful regeneration. The crucial factor underlying its success and attractiveness to investors might be found in its great location within the settled area of the city.

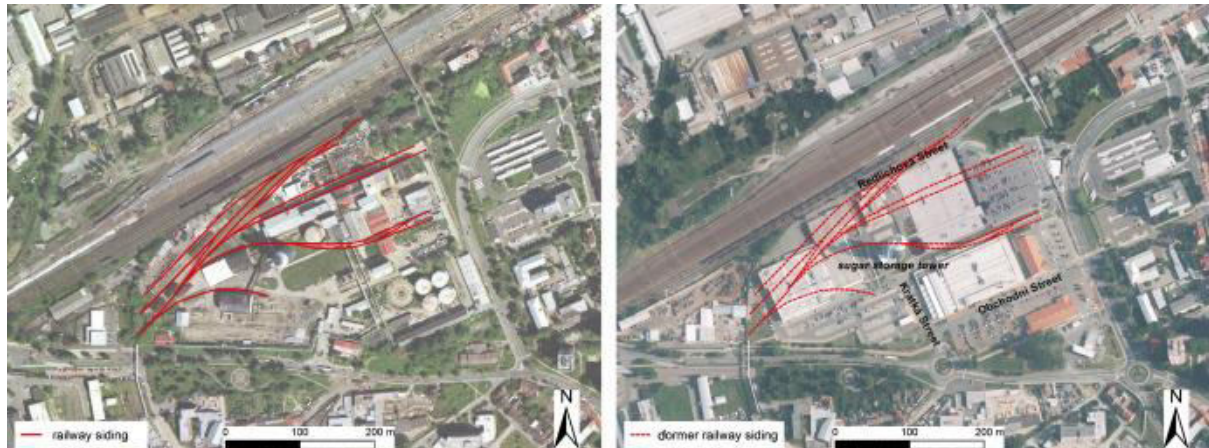


Fig. 3. The area of former sugar beet factory in Hodonín in an aerial picture from 1999 (left) and 2012 (right).

Source: VÚKOZ, v.v.i., GEODIS, s.r.o., ČÚZK.

#### *Sugar beet factory in Nymburk (type CD)*

Another example of the successful amalgamation of a former sugar beet factory into the urban organism can be seen in Nymburk. The area of the factory is also located within the settled area of the city (with a population of about 15 000), in this case in its eastern part. The sugar beet factory in Nymburk was founded in 1871. The history of the factory is closely linked to the activities of the famous Czech inventors František Křižík (1847–1941) and Hanuš Karlík (1850–1927), who headed the sugar beet factory in Nymburk from the 1880s on and contributed to the increased effectiveness of the factory and to improved methods for sugar cleaning. During the times of Hanuš Karlík, the factory was considered as one of the most modern industrial facilities in Europe. The operation of sugar production in Nymburk went on also after the Second World War and following the nationalisation of the property after the 1948 communist putsch in Czechoslovakia. The termination of factory operation dates to 1997, with the demolition of its buildings starting two years later. Demolition was so massive that no visible relics of the site's original use have been preserved, not even the railway siding.

Such a dynamic development was caused by the attractive location of the area, which further enabled a quick reuse of the complete site (see Fig. 4). The first newly built development on the site was a supermarket, to which a warehouse selling garden equipment and a gas station were subsequently added. The northern part of the former factory was used for residential housing development (both single family houses and apartment blocks). The only traces of the sugar beet history of the site are the names of the streets (U cukrovaru – Sugar Beet Factory Street or Řepná – Sugar Beet Street). The name of another street (U Vlečky – Railway Siding Street) references the railway siding that used to be located there, where family houses were built in the period 2006–2010. As a particular speciality of the regenerated site, it might be mentioned that the gardens of these houses are of a curved shape, and copy the area of the former railway siding (Fig. 5). As in the case of Hodonín, the underlying potential of the site led to its utilisation in a new function.





Fig. 4. The area of former sugar beet factory in Nymburk on the aerial picture from 2003 (left) and 2012 (right).

Source: VUKOZ, v.v.i., GEODIS, s.r.o., ČÚZK.



Fig. 5. The supermarket and family houses in the area of former sugar beet factory in Nymburk.

Photo: Marek Havlíček, 2014.

#### *Sugar beet factory in Němčice nad Hanou (type CD)*

The sugar beet factory in Němčice nad Hanou was founded in 1909 as a joint stock company of local farmers, where share ownership depended on supplies of raw sugar beet material to the factory (Lecián, 2009). Thus the factory was closely connected to local farmers from its very beginnings and was strongly dependent on the local production of sugar beets. This ownership structure continued until 1948 and the communist putsch. After the nationalisation of property by the new regime, the sugar beet factory was renamed The Sugar Beet Factory and Refinery in Němčice nad Hanou, National Company. After the collapse of communism, the company reverted to a joint stock company, this time under the name Sugar Beet Factories of Haná. Three years later the factory was sold to an Anglo-French company named Eastern Sugar, which shortly after purchasing it sold their sugar production quotas and ended the operation of their sugar beet factories in the Czech Republic, Slovakia, and Hungary. The last sugar beet campaign in Němčice nad Hanou took place in 2006, and two years later the sugar beet factory was demolished (Lecián, 2009).

This former sugar beet factory might be presented as an already regenerated site with a defunct railway siding presenting no possibility of renewal (i.e., type CD). Nevertheless, the development of this case differs from the previous example in Nymburk. This is caused by the location of this sugar beet factory on the margins of a municipality (Fig. 6) where only about 2000 inhabitants reside. As a consequence, this case is not as potentially attractive to investors as the two above mentioned localities, which are located within the settled areas of larger municipalities (Hodonín, Nymburk). The smaller population of Němčice nad Hanou quite strongly reduces certain regeneration options like industrial or shopping mall reuse. These limitations conditioned the reuse of the site, which, including

the area of the former railway siding, is now covered by a photovoltaic power plant (Figs. 6 and 7). More than half the area of the former sugar beet factory is reserved for the development of single-family houses and apartment buildings, houses for disabled people, smaller sized shops, and a park and playground for children.

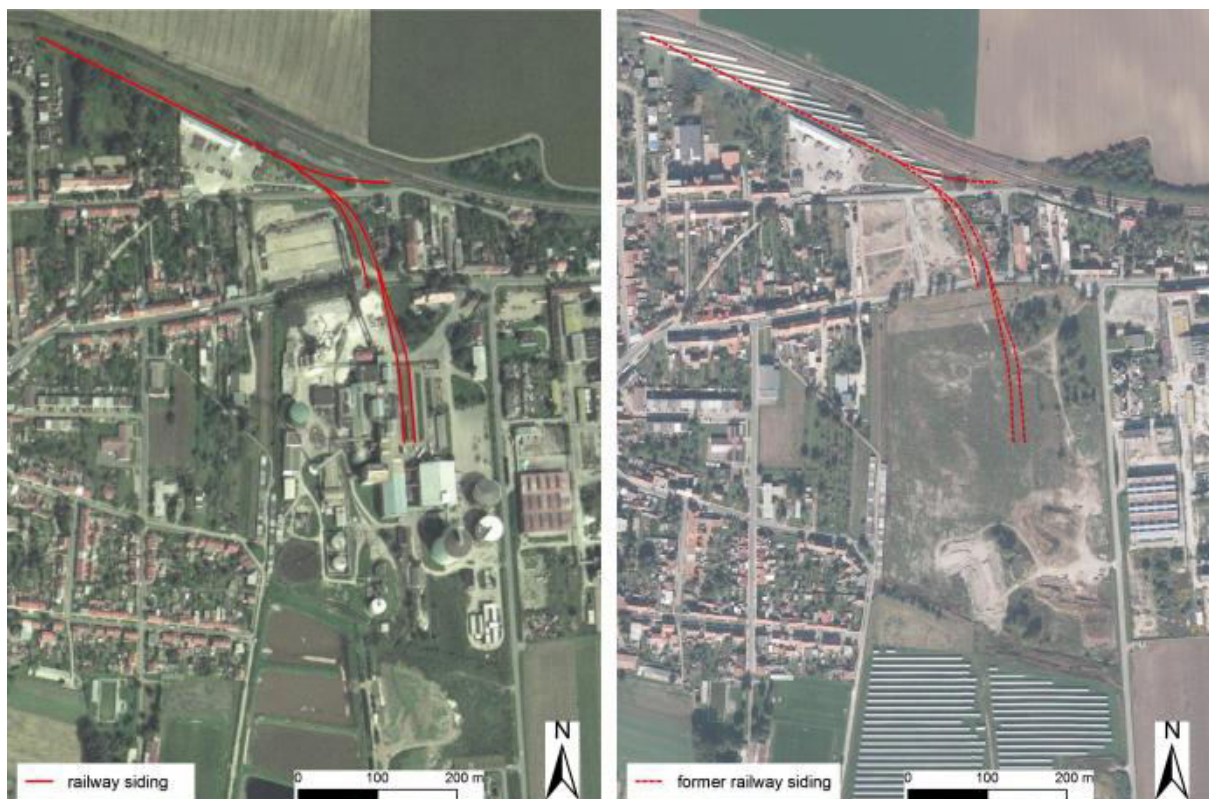


Fig. 6. The area of the former sugar beet factory in Němčice nad Hanou on the aerial picture from 2003 (left) and 2012 (right).

Source: VÚKOZ, v.v.i., GEODIS, s.r.o., ČÚZK.



Fig. 7. The photovoltaic power plant located on the area of former railway siding of former sugar beet factory in Němčice nad Hanou. Photo: Ivo Dostál, 2014.

## Conclusions

The paper has focused on analyses of regeneration options of former sugar beet factories in the Czech Republic by evaluating their development potential. The main argument for being concerned with such abandoned and defunct areas might be seen in the environmental, social, and economic benefits of their reuse in preference to covering green fields with new developments. Examples of successful regenerations from originally industrial zones to greenery (as seen on the example of Toronto, Canada – De Sousa, 2003) and from former mining areas to leisure time parks and tourism (Martinát et al., 2014; Frantál et al., 2013; Navrátil and Švec, 2015) raise positive expectations also for the regeneration of former sugar beet factories.

These expectations are even higher, because former sugar beet factories:

- are well connected to transport, since the original sugar beet processing was concentrated in suitable conditions with a dense settlement structure and proximity of an upper-regional level transport links,
- are connected to railways, multiplying their potential for reuse for industrial or logistic purposes,
- are still partially economically utilised,
- represent localities, where basic infrastructure (water supply, sewerage, gas connection, etc.), is usually present and thus this type of investment is not necessary whilst thinking about regeneration of the site, and
- there is a specific “genius loci” of former sugar beet sites, not often taken into consideration by previously undertaken regenerations, but which nevertheless importantly influences further development of local communities.

On the basis of knowledge gained from this research, the following concluding remarks might be offered:

- Areas of former sugar beet factories are generally of medium size development potential and depends of geographical location of individual sites.
- The transport potential of these sites is based on their original connection via railway sidings just to a limited extent; nevertheless at a quarter of researched former sugar beet factories functional railway sidings can be found. On the other hand, former factories with defunct or unused railway sidings prevail in number. Enormous investment costs might be seen as negative from the economic point of view, if renewal of these railway sidings is considered.
- The beneficial transport potential of former sugar beet factories is primarily based on usually good accessibility to important roads and on their location within the settled areas of municipalities and cities – multi-optional reuse of given areas might be successfully considered.
- The advantage of the transport potential of the former sugar beet factories might be evidenced in the fact that 35 sites have already been regenerated (no matter whether with or without regard to sugar beet industry heritage), and that out of fourteen until now non-regenerated former sugar beet factories the majority are at least minimally utilised as storage spaces or for small production activities.
- The next shift in the utilisation of given areas might be accelerated by targeted activities, like presentations of the “best practices” and by applying pressure on the owners of the sites.
- It would be desirable to develop marketing strategy for regeneration of sugar beet industry brownfields to support their attractiveness for potential investors. Examples of best practices might also serve for attraction of general public to this issue. Such set of best practices of regeneration projects might help to show alternative regeneration options which are in line with industrial heritage of given sites.

Within the Transport 2050 Strategy of the European Union and the White Paper on Transport (2011), the European Union has laid out a vision of shifting long-distance freight transport (defined as over 300 km) from road transport to more environmentally friendly railway or water transport to a level of at least 30% by 2030 (and 50% by 2050). If the strongly limited possibilities of utilising water transport within the Czech Republic are taken into account, it is obvious that fulfilment of such a goal might be achieved primarily by the development of freight railway transport in the near future. Thus it



appears a probable scenario in the near future that the connection of important industrial and logistic zones to the national rail network will gradually increase in importance. Let us also hope that returning brownfields to active economic life will soon find its rightful place in the common strategy frameworks on the European, national, regional, and local levels.

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